

Treatment of Diabetes - A Multivariable Approach

One out of every eleven people in the world is estimated to have diabetes, and about 10% of them have Type 1 diabetes that necessitates exogenous insulin administration for regulating their glucose levels. Automated insulin delivery systems (also called artificial pancreas-AP) have reduced the burden of glucose regulation in people with Type 1 diabetes. Several hybrid closed-loop systems are currently available in the US, where the user is expected to enter manually the meal information or make adjustments for physical activity. The impact of glycemic disturbances such as meals, physical activity, and acute psychological stress cannot be mitigated by fully-automated insulin delivery systems by relying exclusively on continuous glucose monitoring and insulin dosing information. Wearable devices provide valuable data (accelerometer, blood volume pulse/heart rate, galvanic skin response, skin temperature) that can indicate the characteristics of physical activity, stress and sleep states in real time. Signal processing and machine learning techniques can extract valuable personalized patterns of behavior and real-time capture of the user's state from wearable device data to provide proactive (feedforward) control to complement feedback control relying on CGM and insulin information. The technologies for the multivariable AP systems will be presented and the performance of such systems in simulation studies and clinical experiments will be reported.

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